Field Dissipation of Dicamba DGA

Report:	MRID 51017508. Mitchell, J., A. Tunink, T. Xu, and L. Riter. 2020. A Field-Scale Runoff Study to Determine Dicamba Herbicide Runoff Potential Under Furrow Irrigated Soybean Production Conditions. Unpublished study performed by Waterborne Environmental, Inc., Leesburg, Virginia; MOARK Agricultural Research LLC, Fisk, Missouri; AGVISE Laboratories, Northwood, North Dakota; and Eurofins EAG Agroscience, LLC, Columbia, Missouri; and sponsored and submitted by Monsanto Company, Chesterfield, Missouri and BASF Corporation, Research Triangle Park, North Carolina. Study Director Study ID: 229.44. Monsanto Study ID: WBE-2019-0078. Experiment initiation September 3, 2019, and completion January 10, 2020 (p. 6). Final report issued January 10, 2020.
Document No.:	MRID 51017508
Guideline:	OCSPP 835.6100
Statements:	The study was conducted in accordance with USEPA Good Laboratory Practice Standards (40 CFR Part 160), with the following exceptions: test site information; pesticide and crop histories; soil taxonomy; test plot preparation, maintenance and pesticide maintenance applications; and drone footage imagery. Signed and dated Data Confidentiality, GLP, Quality Assurance, and a Certificate of Authenticity were provided (pp. 2-5, and 8).
Classification:	This study is classified **supplemental**. The length of storage of runoff samples was not reported and an independent laboratory method validation was not conducted.
PC Code:	128931

Final EPA Reviewer:	Chuck Peck Senior Fate Scientist	Signature: Date: 2020.10.23 13:44:41 -04'00'
CDM/CSS-Dynamac JV Reviewers:	Dan Hunt, M.S. Environmental Scientist	Signature: Date: 3/28/2020
	Joan Gaidos, Ph.D., Environmental Scientist	Signature: Date: 3/28/2020

This Data Evaluation Record may have been altered by the Environmental Fate and Effects Division subsequent to signing by CDM/CSS-Dynamac JV personnel. The CDM/CSS-Dynamac Joint Venture role does not include establishing Agency policies.

Executive Summary

Runoff of dicamba diglycolamine salt (dicamba DGA; MON 541540; applied as Clarity®, a 480 g a.e./L water-soluble formulation) under U.S. field conditions was examined in cropped plots of dicamba tolerant soybeans at one site near Fisk, Missouri. The nominal application rate for each treated plot was 0.5 lbs. a.e./A. Furrow irrigation was applied to the control and Plot 1 two days after the test substance application (September 5, 2019), while furrow irrigation was applied to Plot 2 seven days after the test substance application (September 10, 2019). Runoff samples were collected from Plot 1 over ten intervals through *ca.* 3 ½ hours and from Plot 2 over twelve intervals through *ca.* 5 ½ hours following the beginning of runoff. The treated plots were 4.6 m apart, and the control plot was *ca.* 32 m away from the nearest treated plot.

Under field conditions at Plot 1, dicamba had runoff concentrations ranging from 377 to 465 µg/L at the start of the runoff event to 21.2 to 39.2 µg/L at the end of the runoff event, with sample concentrations generally decreasing over time. At the end of the study, the total mass lost of dicamba was 0.25% of the target applied amount.

Under field conditions at Plot 2, dicamba had runoff concentrations ranging from 352 to 432 µg/L at the start of the runoff event to 5.73 to 13.8 µg/L at the end of the runoff event, with sample concentrations generally decreasing over time. At the end of the study, the total mass lost of dicamba was 0.12% of the target applied amount.

Runoff volumes were comparable between the control (1885 gal) and treatments on Plot 1 (1723 ± 354 gal) and Plot 2 (1828 ± 465 gal). The flow-weighted average concentrations were 39.7 and 16.8 µg/L for Plots 1 and 2, respectively.

Table 1. Runoff Synopsis

Test System	Sampling Period (minutes after runoff generated)	Maximum Concentrations (µg/L) in Runoff water, at Time Period	Mass Lost (% of applied), at Time Period (days after application)
Missouri – Plot 1 Calhoun soil series Silt loam pH 6.0-6.4	1 (0-10 minutes) 2 (11-21 minutes) 3 (22-33 minutes) 4 (34-44 minutes) 5 (45-55 minutes) 6 (56-66 minutes) 7 (67-77 minutes) 8 (78-108 minutes) 9 (109-139 minutes) 10 (140-200 minutes)	465 190 161 114 71.7 43.2 37.9 26.9 16.8 39.2	0.25%
Missouri – Plot 2 Calhoun soil series Silt loam pH 6.1-6.3	1 (0-10 minutes) 2 (11-21 minutes) 3 (22-33 minutes) 4 (34-44 minutes) 5 (45-55 minutes) 6 (56-66 minutes) 7 (67-77 minutes) 8 (78-108 minutes) 9 (109-139 minutes) 10 (140-200 minutes) 11 (201-261 minutes) 12 (262-322 minutes)	432 139 85.8 45.2 35.5 24.9 29.6 27.7 17.6 23.8 7.41 13.8	0.12%

Sampling period minutes were determined by the reviewer based on information provided in the study report (pp. 23, 30; Table 12, p. 44).

I. Materials and Methods

A. Materials:

1. **Test Material:** Product Name: Clarity® (DGA salt of dicamba (MON 541540); 483 g a.e/L; p. 20; Table 1, p. 33)
   Formulation Type (e.g., liquid or granular): Not reported
   CAS #:104040-79-1 (DER Attachment 1)
   Batch No. 11494387
   Storage stability (expiration date): March 29, 2020 (Table 1, p. 33)
2. **Storage Conditions:** 70-82°F (p. 17)

B. Test Sites:

The site description is provided in **Table 2**. Characterization of irrigation water is provided in **Table 3**. Irrigation water was supplied via on site well.

Table 2. Site Description

Parameter		Value
Site 1: Missouri / Calhoun soil series		
Geographic	Latitude	36.70071

Parameter		Value					
Coordinates	Longitude	90.16106					
	County	Butler					
	Province/State	Missouri					
	Country	USA					
Hydrologic setting - Location within watershed		Not reported					
Slope/Gradient		*ca.* 0.1%					
Depth to Ground Water Table (m)		4-9 inches					
Distance from weather station used for climatic measurements		On-site					
Indicate whether the meteorological conditions before starting or during the study were within 30 year normal levels (Yes/No). If no, provide details.		Not reported					
Field Surface (e.g. bare soil, trees, or crops)		Cropped (DT soybeans, Variety: RJS48014X). Soybean canopy cover was 9.8% on the day of application					
Other Details, if any		None					
Property		Depth (cm)					
		Plot 1			Plot 2		
		0-7.5	7.5-15	15-30	0-7.5	7.5-15	15-30
Textural classification		Silt loam	Silt loam	Silt loam	Silt loam	Silt loam - loam	Silt loam - loam
% sand		24-28	24-26	20-24	22-28	20-34	20-34
% silt		56-60	56-58	58-60	56-60	48-60	50-60
% clay		16	18	18-20	16-18	18-20	16-22
pH (1:1 soil:water)		6.0-6.4	6.6	6.1-6.2	6.1-6.3	6.4-6.8	6.0-6.5
Total organic carbon (%)[1]		0.57-0.70	0.34-0.41	0.21-0.31	0.70-0.75	0.38-0.50	0.24-0.31
Organic matter (%)		0.99-1.2	0.58-0.70	0.37-0.54	1.2-1.3	0.66-0.87	0.41-0.54
CEC (meq/100 g)		7.1-8.2	7.3-7.8	7.1-7.5	7.4-7.9	7.5-8.3	7.2-7.3
AEC (meq/100 g)		NR	NR	NR	NR	NR	NR
Bulk density (g/cm3)		1.11-1.15	1.10-1.19	1.17-1.19	1.07-1.11	1.11-1.17	1.16-1.17
Soil Moisture at 15 bar (%)		9.6-9.8	10.1-10.4	10.2-10.7	7.1-7.5	7.2-7.4	7.2-7.7
Soil Moisture at 1/3 bar (%)		20.5-21.5	20.9-22.2	23.2-24.1	21.4-22.2	21.2-23.8	22.2-24.4
Taxonomic classification		Fine-silty, mixed, active, thermic Typic Glassaqualf (Calhoun soil series)					
Site Usage		Previous Year (2018)		2 years previous (2017)		3 years previous (2016)	
Crops Grown		Rice		Soybeans		Soybeans	
Pesticides Used		Glyphosate, Clomazone, Saflufenacil, Quinclorac, Imazethapyr, Halosulfuron, Propanil, and Thiobencarb[2]		Paraquat, Fomesafen, Metribuzin, Metolachlor, Glufosinate, and Pyroxasulfone		Metribuzin, Metolachlor, Glufosinate, and Glyphosate	
Fertilizers Used		NR		NR		NR	
Cultivation Methods		NR		NR		NR	
Comments		5/18/2019 – Disked field twice 5/28/2019 – Tilled entire field with field cultivator 2x, landplaned, and bedded 8/5/2019 – Disked and tilled with field cultivator 8/6/2019 – Hipped entire field with 60 in. beds					

Parameter	Value
	8/12/2019 – DT Soybeans planted

Data were obtained from pp. 17-19, and 21-22; Tables 2-4, pp. 34-36; and Figures 1-2, pp. 49-50, in the study report. NR = Not reported.
[1]Organic carbon (%) = Organic matter (%)/1.724 (reviewer-calculated).
[2] Pesticides used in 2019 prior to test substance application were glufosinate, flumioxazin, pyroxasulfone, paraquat, and acetochlor (Table 3, p. 35).

Table 3. Irrigation Water Characterization

Parameter	Value	
Site 1: Missouri / Calhoun soil series		
Properties	Replicate 1	Replicate 2
pH	7.6	7.5
Ca [ppm]	91	90
Mg [ppm]	16	16
Na [ppm]	20	29
Hardness [mg equivalent CaCO3/L]	296	291
Conductivity [mmhos/cm]	0.73	0.72
Sodium Adsorption Ratio (SAR)	0.75	0.74
Total Dissolved Solids [ppm]	440	422
Turbidity [NTU]	3.90	2.88

Data were obtained from Table 8, p. 40, in the study report. Irrigation water was collected during the first irrigation event (p. 20).

C. Experimental Design:

Specifications on the design for the runoff study are shown in **Table 4**. Application was made to dicamba tolerant soybeans occurred during the V2 growth stage with some plants approaching the V3 growth stage (pp. 16, 20). Furrow irrigation was applied to the control and Plot 1 two days after the test substance application (September 5, 2019), while furrow irrigation was applied to Plot 2 seven days after the test substance application (September 10, 2019), which the author's stated is more typical timing relative to the application, but still early relative to the crop growth stage. Both trial designs, according to the study authors, are considered to be conservative irrigation scenarios.

At each irrigation event, the well pump supplying the irrigation system was turned on and allowed to run until all furrows in all monitored plots for that event were generating runoff. The well pump was then allowed to run for an additional 18% (first irrigation event) or 5% (second irrigation event) of that duration (pump started to runoff being generated in all furrows) before the well pump was turned off (p. 19). Total applied irrigation was 9,094 gal for Plot 1 and 14,576 gal for Plot 2, which generated 1,332-2,020 gal of runoff for Plot 1 and 1,436-2,341 gal of runoff for Plot 2 (Table 6, p. 38).

Table 4. Study Design

Details		Plot 1	Plot 2
Pesticides used during study [a.i., % a.i., and product]: name of product/a.i concentration: amount applied: application method:		8/13/2019 – Warrant (acetochlor) at 3 pt/A and Liberty (glufosinate) at 32 fl oz/A	8/13/2019 – Warrant (acetochlor) at 3 pt/A and Liberty (glufosinate) at 32 fl oz/A
Amount applied (lbs. a.i./A)		0.5 lbs a.e./A	0.5 lbs a.e./A
Number of applications		One	One
Maximum single labelled application rate? (yes/no)		Yes	Yes
Application method		Broadcast	Broadcast
Application Dates(s) (mm/dd/yyyy)		09/03/2019	09/03/2019
Duration of study		2 days	7 days
Control used (Yes/No)		Yes	No
No. of replications	Controls	One	n/a
	Treatments	Three[1]	Three[1]
Plot size (L x W m)	Control	6.1 x 304.8	n/a
	Treatment	6.1 x 304.8	6.1 x 304.8
Distance between control plot and treated plot		*ca.* 31.9 m	n/a
Distance between treated plots		4.6 m	
Type of spray equipment, if used		Self-propelled sprayer equipped with twelve Teejet TTI 11002 nozzles spaced 20 inches apart and set at a height of *ca.* 20 inches above the crop canopy.	Self-propelled sprayer equipped with twelve Teejet TTI 11002 nozzles spaced 20 inches apart and set at a height of *ca.* 20 inches above the crop canopy.
Total volume of spray solution applied/plot or total amount broadcasted/plot		15.00 gal/A	15.00 gal/A
Identification and volume of carrier (e.g., water), if used		Water, 74.19 gal	Water, 74.19 gal
Name and concentration of co-solvents, adjuvants, and/or surfactants, if used		INDUCE® non-ionic surfactant, 2 pints/100 gal (710 mL)	INDUCE® non-ionic surfactant, 2 pints/100 gal (710 mL)

Details		Plot 1	Plot 2
Indicate whether the following was submitted: Hourly/Daily/Monthly Precipitation Daily/Monthly average minimum and maximum air temperature Daily/Monthly average minimum and maximum soil temperature Average annual frost-free periods		 Daily Daily Avg Daily No	 Daily Daily Avg Daily No
Indicate whether the pan evaporation data were submitted		Daily evapotranspiration was reported	Daily evapotranspiration was reported
Meteorological conditions during application	Cloud cover	0%	0%
	Temperature (°C)	33.7	33.7
	Humidity	55.1%	55.1%
Indicate if any extreme climatic events occurred during the study (e.g., drought, heavy rainfall, flooding, storm, etc.)		Not reported	Not reported
Supplemental irrigation used (Yes/No) If yes, provide the following details: No. of irrigation: Interval between irrigation: Amount of water added each time: Method of irrigation:		9,094 gal	14,576 gal
Indicate whether water received through rainfall + irrigation equals the 30-year average rainfall (Yes/No)		Not reported	Not reported
Were the application rates verified?		Yes	Yes
Were field spikes used?		Yes	Yes
Were good agricultural practices followed (Yes or No)		Normal cultural practices were followed	Normal cultural practices were followed
If cropped plots were used, provide the following details: Plant - Common name/variety: Details of planting: Crop maintenance (e.g., fertilizers used):		 Dicamba tolerant soybeans (Monsanto/Bayer; var. RJS48014X) Planted August 12, 2019 at 140,000 seeds/A, 30-inch spacing. Planted on raised beds, 2 rows/bed None reported	 Dicamba tolerant soybeans (Monsanto/Bayer; var. RJS48014X) Planted August 12, 2019 at 140,000 seeds/A, 30-inch spacing. Planted on raised beds, 2 rows/bed None reported

Details	Plot 1	Plot 2
Was volatilization included in the study? (Yes/No)	No	No
Was leaching included in the study? (Yes/No)	No	No
Was runoff included in the study? (Yes/No)	Yes	Yes
Was plant uptake or canopy monitoring included in the study? (Yes/No)	No	No

Data were obtained from pp. 16-18, and 20-22; Table 5, p. 37; Tables 9-10, pp. 41-42; Figure 2, p. 50; Appendix 1, p. 67; and Appendix 2, pp. 94-103, in the study report.
[1] Each treated replicate plot contained eight crop rows and four irrigated furrows (p. 18; Figure 2, p. 51).

D. Sampling:

Specifications on the methods used for the runoff study are shown in **Table 5**.

Table 5. Sampling

Details	Plot 1	Plot 2
Method of sampling (random or systematic)	Systematic	Systematic
Sampling intervals	At 11 minute intervals for the first hour, every 31 minutes for the second hour, and hourly until runoff stopped or was determined to be insignificant[1].	At 11 minute intervals for the first hour, every 31 minutes for the second hour, and hourly until runoff stopped or was determined to be insignificant[1].
Method of collection	H flumes installed at the downhill side of each plot had a stilling well and auto sampler which was used to collect samples at the flume outlet	H flumes installed at the downhill side of each plot had a stilling well and auto sampler which was used to collect samples at the flume outlet
Sampling depths or heights	n/a	n/a
Number of samples collected per plot	400 mL/sample	400 mL sample
Method of sample processing, if any	None	None
Shipping time to Storage Facility (hours)	Samples were removed within 2 hours and 10 minutes of collection.	Samples were removed within 1 hour of collection.
Storage conditions	Refrigerated (1-10°C)	Refrigerated (1-10°C)
Storage length (days)	Not reported	Not reported

Data were obtained from pp. 16-17, 23, 25; Table 12, p. 44; Figure 4, p. 52; and Appendix 1, p. 71, in the study report.
1 Actual sampling intervals for each replicate are reported in Table 6 of the DER.

E. Analytical Procedures:

Runoff water samples were analyzed for dicamba by method ME-2262 with Eurofins modifications (pp. 17, 25; Appendix 3, p. 117).

Samples (40 mL) were adjusted to pH ≤2.0 using HCL and cleaned on a Oasis HLB SPE cartridge (3cc, 60 mg) eluted with 2 mL methanol (p. 25; Appendix D, p. 160; Appendix 3, pp. 338-339). Water (6 mL) was added to the eluate and analyzed by LC-MS/MS (Phenomenex Kinetex Biphenyl column, 50 mm x 3.0 mm, 2.6 µm) using a mobile phase gradient of 0.05% aqueous formic acid:methanol (80:20 to 45:55 to 5:95, v:v) with electrospray ionization in negative ion mode; Appendix 3, p. 163; Appendix 4, p. 363). The limit of quantification (LOQ) was 0.100 ng/mL, the limit of detection (LOD) was set at 0.03 ng/mL (p. 17; Appendix 4, pp. 346, 350). An alternate dilution only method was employed on some samples, with 0.1 mL aliquots diluted to a volume of 10 mL with methanol:water (25:75, v:v).

F. Verification of the Extraction Method and Storage Stability:

1. Spike Recoveries:

All spike recoveries (procedural recoveries) are within the acceptable range with overall recoveries between 90 and 115% for each fortification level using the primary sample preparation method (0.100 and 10.0 ng/mL) and between 92 and 108% for the alternative sample preparation method (200 and 2500 ng/mL) (Appendix 3, p. 119; Table 5, p. 127).

All method validation recoveries are within the acceptable range with overall recoveries between 93 and 115% for each fortification level using the primary sample preparation method (0.100, 1.00, 100, 10.0 ng/mL) and between 92 and 108% for the alternative sample preparation method (200 and 2500 ng/mL; p. 25; Appendix 4, pp. 348-349; Table 1, pp. 353-356; and p. 533).

Transit stability samples were prepared at the test site on September 5, 2019 at concentrations of 1.00 ng/mL and 10.0 ng/mL (pp. 22, 28). Samples were prepared with runoff water collected from the control plot during the first irrigation event and analyzed 5 days later. The mean recovery for samples fortified at 1.00 ng/mL was 98 ± 4% (n = 6), and 106 ± 8% (n = 6) for samples fortified at 10.0 ng/mL (p. 27; Appendix 3, Table 8, p. 130).

2. Storage Stability Study:

Extract stability was addressed by re-analysis of fortified sample extracts following five days of refrigeration (2-8°C; Appendix 4, p. 349). Mean recoveries were originally 103% and were 92% following the 5-day reinjection (11% decline; Appendix 4, Table 2, pp. 357-358). The length of storage of runoff samples was not reported.

II. Results and Discussion

A. Application Verification:

The test application rate was verified by placing four aluminum pans, each with five 15 cm diameter Whatman #3 filter papers, in each treated plot prior to the test application (p. 21); pans were placed at canopy height. Recoveries achieved on extraction and analysis of application monitors was in the range 80-104% (93 ± 7%) for Plot 1 and 80-110% (93 ± 8%) for Plot 2 (p. 27; Appendix 3, Table 13, p. 45). Mean recoveries from fortified application monitoring samples ranged from 87 to 106% (Appendix 3, Table 1, p. 122).

Additionally, spray tank samples (10 mL) were collected in triplicate prior to and after the test application to verify the concentration of the test substance in the tank mixture (p. 21). The pre-application tank mix sample dicamba concentrations were 97 ± 0.0% (n = 3) of theoretical, and the post-application samples were 97 ± 0.1% (n = 3) of theoretical (p. 27; Appendix 3, Table 4, p. 126).

B. Findings:

Concentrations of constituents measured in the runoff study are shown in **Table 6**. Runoff volumes were comparable between the control (1885 gal) and treatments on Plot 1 (1723 ± 354 gal) and Plot 2 (1828 ± 465 gal) (Table 6, p. 38).

Table 6. Concentration of Dicamba in Runoff Water

		Replicate A			Replicate B			Replicate C		
		Sampling Period Start Date/Time	Sampling Period End Date/Time	Conc (µg/L)	Sampling Period Start Date/Time	Sampling Period End Date/Time	Conc (µg/L)	Sampling Period Start Date/Time	Sampling Period End Date/Time	Conc (µg/L)
Plot 1		9/5/2019	9/5/2019		9/5/2019	9/5/2019		9/5/2019	9/5/2019	
Dicamba	Period 1	7:06	7:16	428	7:12	7:22	465	7:20	7:30	377
	Period 2	7:17	7:27	132	7:23	7:33	190	7:31	7:41	184
	Period 3	7:28	7:38	161	7:34	7:44	92.2	7:42	7:52	95
	Period 4	7:39	7:49	107	7:45	7:55	114	7:53	8:03	82
	Period 5	7:50	8:00	57.7	7:56	8:06	71.7	8:04	8:14	50.6
	Period 6	8:01	8:11	41.2	8:07	8:17	43.2	8:15	8:25	35.4
	Period 7	8:12	8:22	28.5	8:18	8:28	35.9	8:26	8:36	37.9
	Period 8	8:23	8:53	16.4	8:29	8:59	26.9	8:37	9:07	20.3
	Period 9	8:54	9:24	10.8	9:00	9:30	16.8	9:08	9:38	13.1
	Period 10	9:25	10:25	21.2	9:31	10:31	31.5	9:39	10:39	39.2
Plot 2		9/10/2019	9/10/2019		9/10/2019	9/10/2019		9/10/2019	9/10/2019	
Dicamba	Period 1	10:12	10:22	432	10:38	10:48	352	10:49	10:59	362
	Period 2	10:23	10:33	136	10:49	10:59	111	11:00	11:10	139
	Period 3	10:34	10:44	64.6	11:00	11:10	83.2	11:11	11:21	85.8
	Period 4	10:45	10:55	45.2	11:11	11:21	42.9	11:22	11:32	43.9
	Period 5	10:56	11:06	33.5	11:22	11:32	32.7	11:33	11:43	35.5
	Period 6	11:07	11:17	24.9	11:33	11:43	23.1	11:44	11:54	23.7
	Period 7	11:18	11:28	20.2	11:44	11:54	19.8	11:55	12:05	29.6
	Period 8	11:29	11:59	27.7	11:55	12:25	21.7	12:06	12:36	14.5
	Period 9	12:00	12:30	12.9	12:26	12:56	17.6	12:37	13:07	8.55
	Period 10	12:31	13:31	23.8	12:57	13:57	6.26	13:08	14:08	4.11
	Period 11	13:32	14:32	7.41	13:58	14:58	3.45	14:09	15:09	4.93
	Period 12	14:33	15:33	5.73	14:59	15:59	6.35	15:10	16:10	13.8

Data obtained from Tables 14-15, pp. 46-47, in the study report. Sampling times obtained from Table 12, p. 44, in the study report. Sampling period start times were determined by the reviewer based on the text on page 23 of the study report (the first seven samples were collected every 11 minutes, 10 minute intervals with a 1 minute delay to allow time for sampling. Samples 8 and 9 were collected every 31 minutes (30 minute intervals with a 1 minute delay) and any sample after 9, were collected every 61 minutes (60 minute interval with a 1 minute delay).

C. Mass Accounting:

At the end of the study, the total mass lost of dicamba from Plot 1 was 0.25% of the target applied amount and was 0.12% from Plot 2 (p. 29).

Table 7. Summary of Mass Accounting for Runoff [A]

Field Study Module			Percentage of Applied Mass at Time 0 (%)[1]	Maximum Percentage of Applied Mass (%) and Time After Application (days)[1]	Percentage of Applied Mass at Study Termination (%) and Time After Application (days)
Runoff or Water Body (Water and Sediment)	Plot 1	Rep A	0.003	0.043 (Period 7)	0.23 (period 10)
		Rep B	0.060	0.060 (Period 1)	0.32 (period 10)
		Rep C	0.021	0.039 (Period 7)	0.19 (period 10)
	Plot 2	Rep A	0.027	0.054 (Period 10)	0.19 (Period 12)
		Rep B	0.004	0.028 (Period 9)	0.09 (Period 12)
		Rep C	0.002	0.014 (Period 7)	0.07 (Period 12)

[A] Percentages of the applied are based on the target application rate (104.1 g/replicate). Data obtained from p. 29, in the study report (total mass loss).
1 Reviewer-calculated.

Field Study Module			Total Mass Released (g)	Total Flow Released (gal)	Average Conc (µg/L)	Average Conc (µg/L)
Runoff or Water Body (Water and Sediment)	Plot 1 (3.5 hours)	Rep A	0.238	2020	31.3	39.7
		Rep B	0.337	1818	49.1	
		Rep C	0.196	1332	39.0	
	Plot 2 (5.5 hours)	Rep A	0.197	2341	22.7	16.8
		Rep B	0.091	1706	14.2	
		Rep C	0.073	1436	13.6	

Data obtained from p. 29, in the study report (total mass loss).

The flow-weighted average concentrations were 39.7 and 16.8 µg/L for Plots 1 and 2, respectively.

III. Study Deficiencies and Reviewer's Comments

1. The length of storage of runoff samples was not reported.

2. An independent laboratory method validation was not conducted. A method validation study should be completed from an independent laboratory separate from and prior to the analysis of the test samples to verify the analytical methods.

3. The study authors stated that the timing of the test application relative to the crop growth stage and irrigation timing is considered highly conservative for runoff potential, as there is minimal canopy coverage and typically furrow irrigation isn't necessary until the R1 to R3 growth stages (p. 16).

4. The study authors stated that soil moisture content at the test site was higher prior to the first irrigation event than it was at the second event, which led to a lower amount of infiltration at the first irrigation event, because a significant amount of rainfall, 3.98 inches, occurred between planting (August 12, 2019) and the test substance application (September 3, 2019; no other rainfall amounts over 0.01 inches were recorded on any day from 6 days prior to the

application through the second irrigation event). At similar irrigation rates for each event, *ca*. 60% more irrigation was required at the second event to generate similar runoff volume (pp. 28, 30; Table 6, p. 38).

IV. References

1. Riter, L., 2018a. Determination of Dicamba Acid in Tank Mixes by HPLC-UV for Application Rate Verification. ME-2154-01. Monsanto Company, Chesterfield, MO.

2. Riter, L., 2018b. Determination of Dicamba on Filter Paper by HPLC-UV for Application Rate Verification. ME-2166-01. Monsanto Company, Chesterfield, MO.

3. Soil Survey Staff, Natural Resources Conservation Service, United States Department of Agriculture. Web Soil Survey. Available online at: https://websoilsurvey.sc.egov.usda.gov/. Accessed 8/30/2019

4. U.S. EPA, 1989. Pesticide Programs; Good Laboratory Practice Standards; Final Rule (40 CFR, Part 160). Federal Register, Vol. 54, No. 158: 34052-34074. U.S. Environmental Protection Agency, Washington, D.C.

5. U.S. Environmental Protection Agency (USEPA). 2011. Guidance for Evaluating and Calculating Degradation Kinetics in Environmental Media. (Interim draft document dated Dec. 21, 2011.)

6. Vogl, E. and Riter, L., 2019. LC-MS/MS Method for Quantitation of Dicamba in Irrigation Water. ME-2262-01. Monsanto Company, Chesterfield, MO.

Appendix 1: Mass Accounting Calculations

Table 1. Total material balance from runoff expressed as percent of the nominal application rate. Plot 1.

Sample ID		Concentration (µg/L)	Volume of Water Discharged (ft^3)	Mass Loss (g)	Accumulated Mass Loss (g)
Replicate A	Period 1	428	0.26	0.00320	0.00320
	Period 2	132	3.16	0.01182	0.01502
	Period 3	161	7.42	0.03382	0.04885
	Period 4	107	12.77	0.03870	0.08754
	Period 5	57.7	16.64	0.02718	0.11473
	Period 6	41.2	17.79	0.02075	0.13548
	Period 7	28.5	55.05	0.04443	0.17991
	Period 8	16.4	60.01	0.02787	0.20777
	Period 9	10.8	91.59	0.02801	0.23579
	Period 10	21.2	3.95	0.00237	0.23816
	Total mass loss (% of applied)				0.23
Replicate B	Period 1	465	4.74	0.06238	0.06238
	Period 2	190	6.38	0.03435	0.09673
	Period 3	92.2	9.15	0.02388	0.12061
	Period 4	114	12.87	0.04156	0.16217
	Period 5	71.7	14.16	0.02876	0.19093
	Period 6	43.2	14.34	0.01754	0.20846
	Period 7	35.9	46.15	0.04692	0.25538
	Period 8	26.9	52.63	0.04009	0.29547
	Period 9	16.8	76.01	0.03616	0.33163
	Period 10	31.5	6.28	0.00561	0.33723
	Total mass loss (% of applied)				0.32
Replicate C	Period 1	377	2.07	0.02205	0.02205
	Period 2	184	5.13	0.02675	0.04880
	Period 3	95	6.09	0.01637	0.06517
	Period 4	82	7.63	0.01771	0.08288
	Period 5	50.6	10.14	0.01453	0.09741
	Period 6	35.4	11.3	0.01133	0.10874
	Period 7	37.9	38.03	0.04081	0.14955
	Period 8	20.3	46.41	0.02668	0.17623
	Period 9	13.1	49.59	0.01839	0.19462
	Period 10	39.2	1.51	0.00168	0.1963
	Total mass loss (% of applied)				0.19

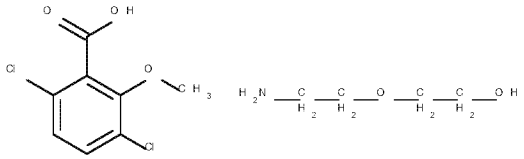
Data obtained from Table 14, p. 46, in the study report.

Table 2. Total material balance from runoff expressed as percent of the nominal application rate. Plot 2.

Sample ID		Concentration (µg/L)	Volume of Water Discharged (ft^3)	Mass Loss (g)	Accumulated Mass Loss (g)
Replicate A	Period 1	432	2.29	0.02800	0.02800
	Period 2	136	3.87	0.01490	0.04290
	Period 3	64.6	4.40	0.00806	0.05095
	Period 4	45.2	5.10	0.00653	0.05748
	Period 5	33.5	5.50	0.00522	0.06270
	Period 6	24.9	6.20	0.00437	0.06707
	Period 7	20.2	20.75	0.01187	0.07894
	Period 8	27.7	25.44	0.01995	0.09890
	Period 9	12.9	59.01	0.02156	0.12045
	Period 10	23.8	83.84	0.05651	0.17696
	Period 11	7.41	86.44	0.01814	0.19510
	Period 12	5.73	9.95	0.00161	0.19671
	Total mass loss (% of applied)				0.19
Replicate B	Period 1	352	0.45	0.00445	0.00445
	Period 2	111	1.00	0.00316	0.00761
	Period 3	83.2	2.37	0.00559	0.01320
	Period 4	42.9	3.37	0.00409	0.01729
	Period 5	32.7	3.68	0.00341	0.02070
	Period 6	23.1	4.14	0.00271	0.02340
	Period 7	19.8	15.14	0.00849	0.03189
	Period 8	21.7	21.59	0.01327	0.04516
	Period 9	17.6	57.45	0.02863	0.07379
	Period 10	6.26	70.30	0.01246	0.08625
	Period 11	3.45	46.98	0.00459	0.09084
	Period 12	6.35	1.36	0.00024	0.09109
	Total mass loss (% of applied)				0.09
Replicate C	Period 1	362	0.21	0.00216	0.00216
	Period 2	139	1.63	0.00641	0.00856
	Period 3	85.8	2.74	0.00666	0.01522
	Period 4	43.9	3.36	0.00417	0.01940
	Period 5	35.5	4.24	0.00426	0.02366
	Period 6	23.7	4.55	0.00306	0.02671
	Period 7	29.6	17.56	0.01472	0.04143
	Period 8	14.5	22.04	0.00905	0.05048
	Period 9	8.55	46.78	0.01133	0.06180
	Period 10	4.11	58.61	0.00682	0.06863
	Period 11	4.93	29.67	0.00414	0.07277
	Period 12	13.8	0.33	0.00013	0.07290
	Total mass loss (% of applied)				0.07

Data obtained from Table 15, p. 47, in the study report.

DER ATTACHMENT 1. Dicamba-diglycolamine and Its Environmental Transformation Products. [A]

Code Name/ Synonym	Chemical Name	Chemical Structure	Study Type	MRID	Maximum %AR (day)	Final %AR (study length)
PARENT						
Dicamba-diglycolamine (MON 541540; Diglycolamine salt of dicamba)	**IUPAC:** 3,6-Dichloro-o-anisic acid-2-(2-aminoethoxy)ethanol **CAS:** 2-(2-Aminoethoxy)ethanol;3,6-dichloro-2-methoxy-benzoic acid **CAS No.:** 104040-79-1 **Formula:** $C_{12}H_{17}Cl_2NO_5$ **MW:** 326.17 g/mol **SMILES:** COc1c(Cl)ccc(Cl)c1C(=O)O.NCCOCCO		835.6100 Terrestrial field dissipation	51017508	NA	NA
MAJOR (>10%) TRANSFORMATION PRODUCTS						
No major transformation products were identified.						
MINOR (<10%) TRANSFORMATION PRODUCTS						
No minor transformation products were identified.						
REFERENCE COMPOUNDS NOT IDENTIFIED						
All compounds used as reference compounds were identified.						

[A] AR means "applied radioactivity". MW means "molecular weight". NA means "not applicable".

Attachment 2: Statistics Spreadsheets and Graphs

128931_51017508_83
5.6100_calculations.xls